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ABSTRACT

A series of three experiments with suburban elementary students tested the facilitative effect of metaphors on children's ability to understand and remember what they read. In the first study, sixth grade students read two unfamiliar passages and were able to recall metaphoric structures better than literal paraphrases of the same information. In the second study, third grade subjects read a more familiar passage and exhibited no difference in recalling metaphors and literal descriptions. In the third study, in which third and sixth grade students read familiar and unfamiliar metaphors and literal material, there was a significant passage familiarity by version (metaphor or literal) interaction. Conclusions drawn from the three studies were that (1) children's recall of metaphor is always as good as and often better than their recall of comparable literal paraphrases; (2) when passage material is familiar, metaphors are no more salient than their literal counterparts; (3) whatever metaphor effects exist appear limited to their surface structure boundaries. The possibility exists that metaphors are better recalled than literal passages not because they elicit greater comprehension, but because they are more vivid and novel and, therefore, more memorable. (AEA)

CENTER FOR THE STUDY OF READING

Technical Report No. 131

THE FUNCTION OF METAPHOR IN CHILDREN'S RECALL OF EXPOSITORY PASSAGES

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Abstract

In a series of three studies, the facilitative effect of metaphors on children's recall of expository passages was evaluated. In Experiment I, with sixth grade subjects and an unfamiliar passage, metaphor target structures were recalled better than their literal paraphrases. In Experiment II, using third grade subjects and a more familiar passage, there were no differences between metaphor and literal versions of passage in terms of the recall of target structures. In Experiment III, which was designed to eliminate the passage familiarity x grade level/experiment confounding, there was a significant passage familiarity by version (metaphor or literal) interaction. Metaphors facilitated target structure recall only for unfamiliar passages. These data were interpreted as supporting the view that metaphors can serve the function of bridging new and old information in unfamiliar textual settings.

The Function of Metaphor in Children's Recall of Expository Passages

For the better part of three millenia, scholars have grappled with metaphor as a linguistic and literary phenomenon. Theories about its nature and function have risen, fallen, and been resurrected. Recently, metaphor has been the object of a renaissance among philosophers, linguists, and psychologists (Ortony, in press). Educators, too, have developed an interest in metaphor in the context of their more general concern for the development of children's abilities to deal with figurative language.

Educators have had two major concerns: first, to determine when, in the course of a reading and language arts curriculum, they could safely begin including figurative language in children's reading selections; second, to determine when they could begin direct instructional activites dealing with figurative language. The conventional wisdom has been to avoid instruction in figurative language until the intermediate grades (4-6) but to allow it to creep gradual'y into stories and expositions as early as grade one.[1] These concerns appear to be motivated by a fear that children will interpret figurative language literally and hence become confused about the topic under discussion. Indeed just such a fear can find support in some of the research studies that have concluded that children have difficulty with metaphor until early adolescence (e.g., Asch& Nerlove, 1960; Winner, Rosenstein, & Gardner, 1976).

However such research findings may not be entirely reliable. First, other studies have suggested that figurative language expressions may be comprehensible to children as young as first grade in certain conditions (e.g., Gentner, 1977; Horne, 1966; Mayer, 1975; Pollio & Pollio, 1974; Reynolds & Ortony, Note 1). Second, Ortony (in press) and Ortony, Reynolds, and Arter (1978) have criticized much of the metaphor research on methodological grounds, arguing, for example, that the research has not adequately controlled for response bias or world knowledge. With respect to response bias their argument is that children may simply choose to respond literally even when they do in fact understand the metaphor.

The world knowledge problem is more serious for it can lead to erroneous conclusions about children's abilities to understand how metaphors work. Consider the metaphor, "science is an iceberg." The topic is science; the vehicle is iceberg. The ground of that metaphor is the commonality shared by science and iceberg. The tension results from the incompatibility (lack of shared features) of the two terms, science and iceberg, when considered literally. Children may fail to understand the metaphor, "science is an iceberg," because they know nothing about the vehicle, iceberg, rather than because they do not understand how metaphors work. A third problem occurs when children may respond literally because they do not understand the task demands. They aren't aware that the the investigator wants an answer that is a metaphor. Thus the literal answer does not reflect inability to use metaphor, only a lack of understanding of the task. These criticisms of Ortony and his collaborators

suggest caution in any conclusions drawn concerning children's ability to understand metaphor.

Returning to the issue of the role of metaphor in text comprehension, Petrie (in press) has suggested that metaphors may serve a bridging function for the reader. That is, metaphors may allow a reader to transfer knowledge from the known (the vehicles of the metaphors) to the new (the topics of the metaphors). Consistent with Petrie's suggestion, Arter (1976) approached the metaphor issue from a different perspective, looking for their facilitating rather than their interfering properties. She hypothesized that metaphorical language may serve two intertwined roles. First, if the vehicles are well-known to children, they may serve the bridging function suggested by Petrie. Second, metaphors (as literary scholars might argue) add interest and vividness to prose. Hence, if properly constructed and set in appropriate prose contexts, metaphors may actually facilitate comprehension and recall of text. Arter's results failed to corroborate these hypotheses. She found no differences between sixth grade students' comprehension and recall of passages containing metaphors and those containing literal paraphrases that had been rated by judges to be equivalent in meaning to the metaphors. She did note that she may have experienced methodological difficulties in selecting known vehicles and choosing appropriate subject matter, and as a result of using a written rather than an oral response mode for students' free recall protocols.

The present set of studies were motivated by Arter's research. First, we were impressed by the fact that she found the metaphorical versions of

the passages at least as comprehensible and memorable as the literal versions, thus weakening the beliefs of previous researchers and the assumptions implicit in educational practice regarding figurative language and young children's inability to understand it. Second, we were interested in finding support for her original hypothesis by generating metaphors that used vehicles we were certain were familiar to the children, and by using a different content. Third, we decided to extend her methodology to different populations of students and new passages.

Experiment I

Method

The sample for Experiment I consisted of 20 sixth grade students of average reading ability (as determined by teacher judgment) and 20 undergraduate students from the University of Minnesota.

Two versions of a passage about the pyramids of Egypt (Branson, 1976) were adapted for the study. One version contained exactly 10 metaphors interspersed among its 539 words. The literal version contained only 510 words, but the same number of propositions (Thorndyke, 1977) as the metaphor version. Five independent judges, each reading both versions of each story, rated the two versions as being highly similar in meaning. In addition, a pilot study, using subjects from the same population, revealed that all subjects knew all 10 of the vehicles used in the metaphors. The sample paragraph below shows the metaphor used (underlined), followed by the paraphrase used in literal version (in parentheses):

> Along the banks of the Nile River in Egypt stand the world's oldest stone buildings--the pyramids. Once those Egyptian pyramids shone (1) as white as piles of snow on a sunny day (gleaming white). Today they are more than 5,000 years old. No wonder they look a bit rundown! But the pyramids are still one of the wonders of the world. And they are lasting evidence of the Egyptian's belief in a life after death.

Ten comprehension probes were developed to assess comprehension of the ten target structures that differed from one version to the other. For example, the probe corresponding to the paragraph described above asked, "How did the pyramids look when they were just built?"

Subjects were tested individually. They were asked to read the passage carefully in order to be able to answer questions about it later. After a 2 minute interpolated task, subjects were asked to recall as much as they could from the story even if they could not remember exact words. Then subjects were asked questions for each of the target structures that they did not report in the free recall stage.

Recall protocols were analyzed in two ways. First, a gist criterion was used for the manipulated target structures (i.e., did or did not the subject get the sense of the metaphor or its literal paraphrase). Second, both versions were divided into propositions, using Thorndyke's (1977) methodology. Recall protocols were scored according to their match with the text. For scoring propositions, an interjudge reliability of .98 was obtained on a 10% sample of the protocols.

Two way analyses of variance (age by version) were carried out for each of the following dependent measures: gist recall of the manipulated

pairs of structures (free as well as free-plus-probed recall), recall of the same manipulated pairs using a propositional breakdown, recall of incidental propositions (propositions not in the manipulated target structures).

Results and Discussion

The data for gist recall and the propositional breakdown did not differ; hence only the gist recall data is reported. For free recall of target structures (see Table 1), there are reliable differences attributable to both age, $F(1,36) = 20.57$, $p < .01$, and version, $F(1,36) = 18.4$, $p < .01$. Similarly, for free-plus-probed gist recall (see Table 2), both the age, $F(1,36) = 36.54$, $p < .01$, and version, $F(1,36) = 20.31$, $p < .01$, factors revealed significant effects. In neither of these analyses was there a significant interaction effect.

Insert Tables 1 and 2 about here.

In contrast to Arter's findings, the presence of metaphors appears to have had a facilitative effect on recall of selected target structures. Incidentally, Arter found that her sixth grade subjects recalled only about 5% of her target structures using a written recall task. Here, using an oral recall task, sixth grade students recalled 42% of the metaphor structures and 18% of their literal paraphrases. Granting the confounding of passage content and recall modality between the studies, we are tempted to conclude that a writing task imposes a major constraint on children's disposition to recall passage content, perhaps masking any real differences.

The facilitative effect of metaphors does not ex end beyond their surface structure boundaries, however. In recall of incidental propositions (see Table 3), there was a significant age effect, $F(1,36) = 17.90$, $p < .01$. However, neither the version nor the interactive effect was significant.

Insert Table 3 about here.

Experiment II

Having been encouraged by the data in Experiment I, supporting the facilitative effect of metaphors on older children's recall of specific target structures within an expository passage, we decided to extend the methodology to a younger age (third grade) and include a reading ability variable.

Method

The sample was randomly drawn from the populations of high ability (reading above grade level) and low ability (reading below grade level) third grade students at an elementary school within a middle class suburban area near Minneapolis.

Using a passage about water pollution in the Connecticut River, written at about third grade readability level, procedures identical to those in Experiment I were used to generate metaphor and literal versions of the passage and the ten comprehension probes. The passage was shorter, however--some 282 words for the metaphor version and 267 words for the literal version.

Data collection and protocol scoring procedures were identical to those used in Experiment I. Analyses of variance for the dependent measures were conducted using reading ability and version as between-subjects factors.

Results

The analysis for free recall of target structures revealed a significant main effect for ability, $F(1,36) = 9.31$, $p < .01$, but no main effect for version and no interaction effect (see Table 4). The analysis for free-plus-probed recall yielded the same pattern of effects; the ability effect being significant beyond the .01 level, $F(1,36) = 16.20$ (see Table 5). Recall of incidental propositions likewise yielded a significant ability effect, $F(1,36) = 22.40$, $p < .01$, but no version or interaction effect (see Table 6).

Insert Tables 4, 5, and 6 about here.

These data stand in stark contrast to the data from Experiment I. Here there were no effects associated with the inclusion or exclusion of metaphors, even for the target structures. When we noticed the contrast, we wondered whether we had found a real developmental difference or just a passage effect. Notice that passage and grade level are completely confounded between Experiments I and II.

Hence we decided to do a small scale follow-up study with a group of average ability sixth grade students. Using a total of 20 subjects, 5 were randomly assigned to each of four conditions: pyramid-metaphor,

pyramid-literal, pollution-metaphor, and pollution-literal. We calculated only the total (free-plus-probe) recall of target structures.

These data are reported in Table 7. While there are some differences between the data in Experiment I and these data, the differences for the pyramid passage are in the same direction as in Experiment I, whereas the data for the pollution passage look more like the data for the third grade students in Experiment II, except that they are at a higher overall level of recall.

Insert Table 7 about here.

The discrepancies between Experiments I and II invite certain speculations about the possible confounding of subject matter familiarity and experiment. It seems reasonable to conclude that most sixth grade students' knowledge of pyramids is, at best, sketchy. However, even third grade children (especially those living within a few miles of the Mississippi River as it passes through the polluting environment of a major metropolitan area) may know quite a bit about water pollution.

If a function of metaphor is to help students bridge from the known (the vehicle) to the new (the topic), it may well be the case that metaphors can only serve this function in situations where students are reading relatively unfamiliar material. With familiar material, the metaphors may be unnecessary, uninteresting, and possibly even distracting to students; hence, they do not stand out or remain long in memory.

To investigate this hypothesis, we undertook Experiment III.

Experiment III

Method

Twenty third and twenty sixth grade students from a central Illinois elementary school participated in the study: ten children of high and ten of low reading ability at each grade level. Ability was determined by the reading group to which each child belonged.

Four passages were constructed for each grade level to allow the manipulation of topic familiarity and metaphoricity. Therefore, at each grade level there existed four versions: (a) familiar-metaphor, (b) less familiar-metaphor, ( ) familiar-literal, and (d) les familiar-literal. Embedded in each version were ten target structures, which were written as either a metaphor or a literal paraphrase, depending on the version. Each child read both stories in either the metaphor or the literal condition for his or her grade level. Two of the passages used came from Experiments I and II. The pyramid article served as the less familiar sixth grade passage; the water pollution article served as the familiar third grade passage. A story about cowboys was the familiar sixth grade passage, and an article about deep-sea exploring vessels was the less familiar third grade passage. As in Experiments I and II, judges were used to rate the similarity of the metaphor versus literal versions, finding that the two versions were highly similar.

The students were tested individually by one of two experimenters in an empty classroom. The sessions were recorded and later transcribed for scoring. Children began by reading the first passage assigned;

then, following a 2 minute interpolated task, they recalled everything they could remember from the story. This completed, they answered ten probe questions on the ten target structures embedded within the story. This procedure was repeated for the second story. A two part debriefing followed. In the first part subjects answered questions to determine their knowledge of the vehicles used in the metaphor; in the second part they answered questions about interest, ease of reading and understanding, and familiarity of the topic.

Scoring

The protocols were scored using functional idea units (Anderson & Pichert, 1978) and propositions (Turner & Greene, 1977) as units of analysis. Using functional idea units, free recall responses were categorized under the following headings:

1. text-based target structure and incidental idea units--the idea unit mapped onto a corresponding idea unit in the original text.
2. recall convention--markers such as "these are" or "it said."
3. hedges--statements such as "I think it said" or "I can't remember exactly."
4. incorrect text integration--joining two idea units to form an incorrect statement.
5. intrusions (consistent or inconsistent)--consistent intrusions followed logically from some statement in the original text; inconsistent intrusions were those unrelated to the story.

For the probe question protocols, similar criteria were used. An answer was classified as:

1. target--restatement of the target structure
2. correct--a semantically equivalent paraphrase of the target structure
3. incorrect

In later analyses, both "target" and "correct" responses were scored as correct.

Interjudge reliability for a 10% sample of protocols for both scoring procedures results in a 90% agreement factor between two independent judges.

For purposes of the present study, only the data for the functional idea unit protocols were analyzed. Analyses of variance were conducted for three dependent measures: free recall of target structures, probed recall of target structures, and recall of incidental textual idea units. A preliminary analysis revealed no significant main or interaction effects for the passage order variable so it was dropped from all further analyses. Between subjects factors for the analyses were version (metaphor or literal), grade (third or sixth), and ability (high or low). The one within-subject factor was familiarity (more or less).

Results

The analysis of free recall of target structures suffers from what appears to be a "floor" effect. None of the main effects and only one out of six interaction effects proved to be statistically significant. On the average students voluntarily recalled or about one out of ten

target propositions. In such a circumstance, it is probably meaningless to try to interpret the significant three way interaction between grade, version, and familiarity.

When students responded to probe questions designed to elicit target sentences,[2] main effects were found for ability level, $F = 13.90$, $p < .01$, and familiarity, $F = 10.97$, $p < .01$. These effects are complicated by three significant two way interactions. The grade x ability level interaction, $F = 4.24$, $p < .05$ (see Table 8), indicates that the ability differences are sharper at grade six than at grade three. Similarly, the grade by familiarity interaction, $F = 7.09$, $p < .01$, (see Table 9), indicates a greater disparity between levels of familiarity at grade six than at grade three. Finally, the version by familiarity interaction, $F = 5.17$, $p < .05$, indicates the lack of a facilitative effect for metaphors when material is familiar in contrast to the presence of facilitation for metaphors in unfamiliar material. Because different passages were used at each grade level, we examined the version x familiarity interaction at each grade level individually, with similar results (see Table 10). At each level, the metaphor versus literal comparison was significant only for the unfamiliar passage. This version by familiarity interaction is, of course, precisely what we predicted based upon our speculation about the possible confounding between Experiments I ard II.

Insert Tables 8, 9, and 10 about here.

Finally the free recall for incidental idea units (see Table 11) revealed significant effects for grade, $F = 3.74$, $p < .01$, and ability

level, $F = 25.47$, $p < .01$, and the interaction between the two $F = 7.70$, $p < .01$. There was no difference attributable to version, thus corroborating the findings in Experiments I and II. Surprisingly, however, familiarity also failed to show an overall effect.

Insert Table II about here.

General Discussion

Across the three experiments there are patterns of regularity. What is remarkable, perhaps, is that children's and adults' recall of metaphor is always as good as and often better than their recall of comparable literal paraphrases. This is true even for 9-year-olds with low reading ability (about low second grade level). We hasten to add that this statement can be made only for situations in which there is a very high probability that the vehicle of the metaphor is within the subjects' store of world knowledge. In Experiment III, for example, our debriefing revealed only one subject who did not know all of the vehicles for the metaphors used in both passages.

Second, the role of metaphor as a bridging device appears to depend upon passage familiarity. When the passage material is familiar, metaphors are no more salient than their literal counterparts. When the passage material is less familiar, metaphors seem to assume greater salience, which may in fact be attributable to that bridging function hypothesized by Arter and Petrie.

Third, whatever metaphor effects exist appear limited to their surface structure boundaries. They appear not to exhibit clustering capabilities, as evidenced by their failure to elicit greater incidental recall than their literal paraphrases.

All three of these generalizations, but most particularly the second, suffer slightly from the fact that in Experiment III there was no familiarity effect for recall of incidental idea units or for intrusions into recall that were thematically consistent with the topics of the passage. Surely familiar passages should have elicited greater free recall and consistent intrusions than unfamiliar passages. Such a failure leads us to question the validity of our judgments about familiarity. In the debriefing, the sixth grade subjects consistently rated the pyramid passage as less familiar while the third grade subjects were more evenly split (with the nod going to the sea vessels passage as least familiar). Clearly, however, we have only begun to tap the surface of this familiarity issue.

Regarding our third generalization about the lack of any clustering capability for metaphors, we would argue that we have not provided a fair test. What needs to be done is to vary the position of a given metaphor within a text structure hierarchy; for example, metaphors may elicit better recall of surrounding propositions than their literal paraphrases when they appear as "main ideas" but only equal recall when they appear as "details." In fact, in a study using metaphors and literal paraphrases as summary statements, overall recall was better for the metaphor condition (Reynolds, Schwartz, & Esposito, Note 2).

Finally, we offer some caution about our free and probed recall measures. It is possible that metaphors are better recalled than literal paraphrases not because they elicit greater comprehension but only because they are more vivid and more novel and, hence, more salient and memorable. We need to test the metaphor effect with other comprehension metrics (perhaps some paraphrase recognition task) lest we draw conclusions that are too hold for our methodology.

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Footnotes

This research was concluded while Pearson and Raphael were on leave from the University of Minnesota. It was supported by the National Institute of Education under Contract No. US-NIE-C-400-76-0116.

[1]Arter (1976) found that approximately 1% of running text in basal readers represented figurative uses of language.

[2]This measure is comparable to the free plus probed recall in Experiments I and II. In fact, no child ever recalled anything in free recall that he did not recall in the probed recall phase.

[3]Reynolds, R. E., & Ortony, A. (Note 1).

Table 1

Mean Free Recall of Target Structures

(Experiment 1)

	Version		
Age	Literal	Metaphor	$\bar{M}_{age}$
Child	1.1	2.5	1.8
Adult	2.6	4.7	3.65
$\bar{M}_{version}$	1.85	3.6	

Table 2

Free Rius Probe Recall of Target Structures

(Experiment I)

Age	Version: Literal M	Version: Metaphor M	M age
Child	1.8	4.2	3.0
Adults	4.9	6.6	5.75
M version	3.35	5.4	

Table 3

Free Recall of Incidental Propositions

(Experiment 1)

	Version		
Age	Literal M	Metaphor M	M age
Child	12.4	13.9	13.15
Adult	20.9	21.5	21.20
M version	16.6	17.7	

Table 4

Free Recall of Target Structures for

Third Grade Students (Experiment II)

Ability	Version: Literal M	Version: Metaphor M	M ability
Low	1.0	.8	.9
High	1.6	2.1	1.85
M version	1.3	1.45	

Table 5

Free and Probe Recall of Target Structures

for Third Grade Students (Experiment II)

	Version		
Ability	Literal M	Metaphor M	$\bar{M}$ Ability
Low	3.2	3.1	3.15
High	5.3	5.3	5.30
$\bar{M}$ version	4.25	4.2	

Table 6

Free Recall of Incidental Propositions for Third Grade Students (Experiment II)

Ability	Version: Literal M	Version: Metaphor M	M Ability
Low	2.1	2.4	2.25
High	5.3	4.3	4.8
M Version	3.7	3.4	

Table 7

Free and Probe Recall of Target Propositions Across Experiment I and II for the Two Passages (Sixth Grade Students)

	Version		
	Literal	Metaphor	
Passage	M	M	M Passages
Pyramid	3.4	4.2	3.8
Water Pollution	7.0	6.6	6.8
M version	5.2	5.4	

Table 8

Grade x Ability Interaction for

Probed Recall (Experiment III)

	Ability		
Grade	High	Low	$\bar{M}_{Grade}$
Three	4.10	3.35	3.725
Six	5.50	.90	4.2
$\bar{M}_{Ability}$	4.8	3.125	

Table 9

Grade x Familiarity Interaction for

Probed Recall (Experiment III)

Grade	Familiarity		$\bar{M}_{Grade}$
	More Familiar	Less Familiar	
Three	3.85	3.60	3.725
Six	5.35	3.05	4.20
$\bar{M}_{Familiarity}$	4.60	3.325	

Table 10

Version x Familiarity
Interaction for Probed Recall (Experiment III)

Familiarity	Version	
	Metaphor	Literal
Grade 3		
More	3.3	4.4
Less	4.5	2.7
Grade 6		
More	5.6	5.1
Less	3.6	2.5

Table 11

Grade x Level Interaction for Free Recall

of Incidental Information (Experiment III)

	Grade		
Ability	Three	Six	$\bar{M}_{Ability}$
High	11.45	23.30	17.375
Low	7.3	9.00	8.15
$\bar{M}_{Grade}$	9.375	16.15	

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